Systems and Methods for Broadcasting Information Additive Codes

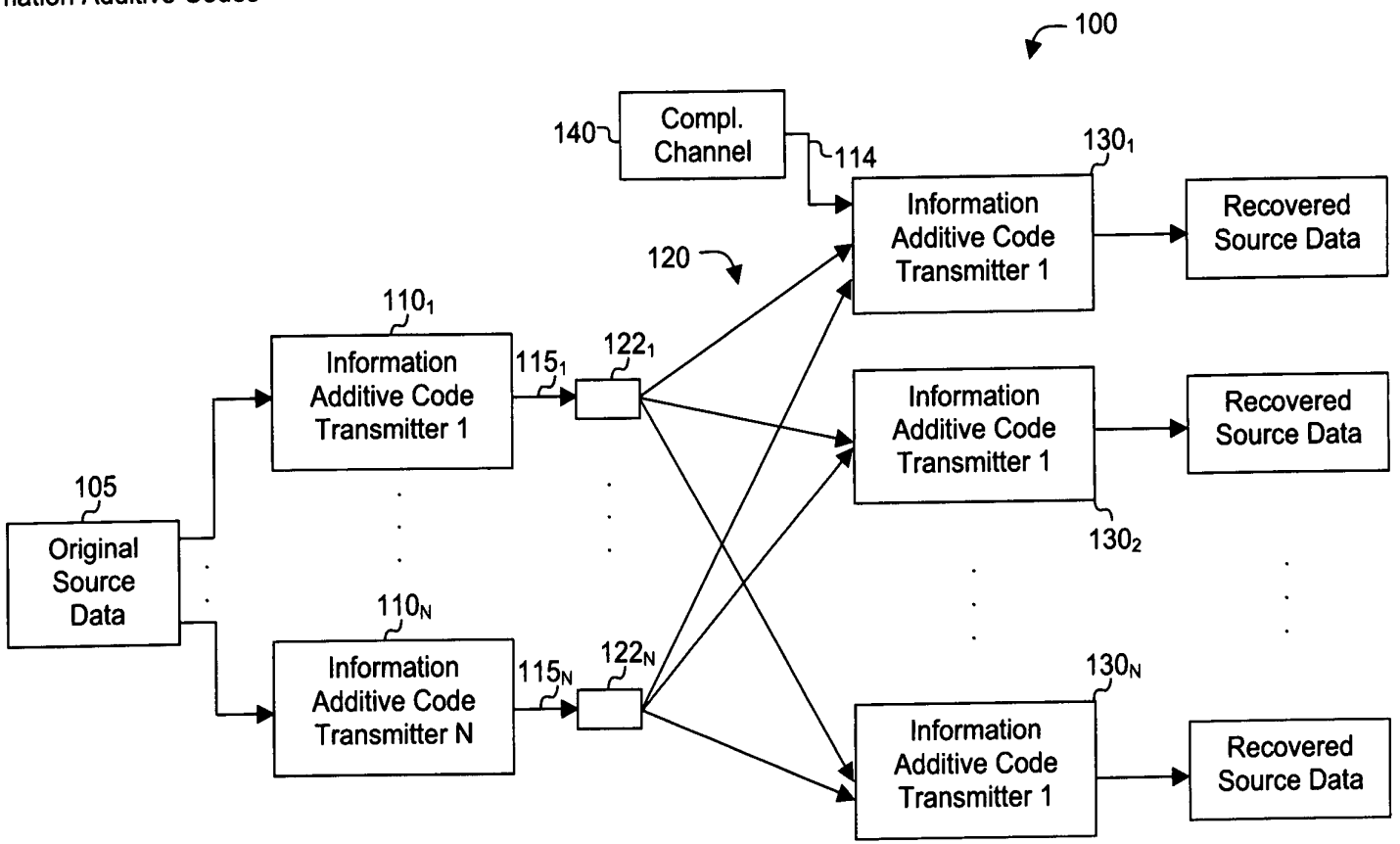

Fig. 1A

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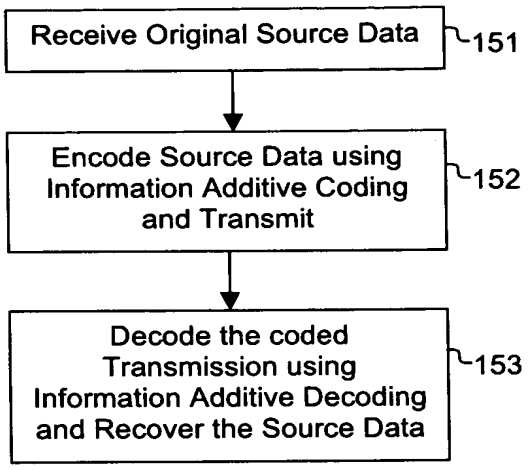
Receive Original Source Data
151
Encode Source Data using Information Additive Coding and Transmit
152
Decode the coded Transmission using Information Additive Decoding and Recover the Source Data
153

Fig. 1B

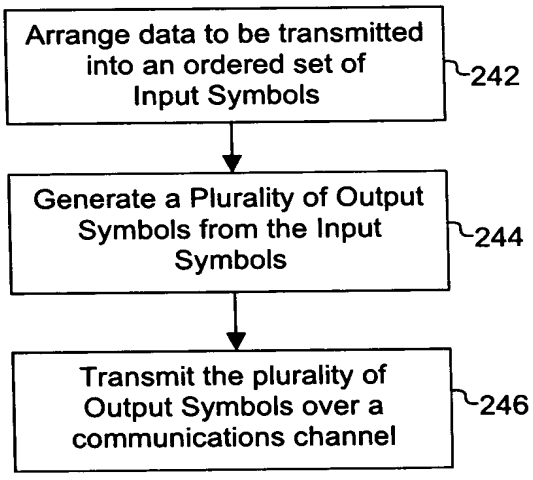
Arrange data to be transmitted into an ordered set of Input Symbols
242
Generate a Plurality of Output Symbols from the Input Symbols
244
Transmit the plurality of Output Symbols over a communications channel
246

Fig. 2B

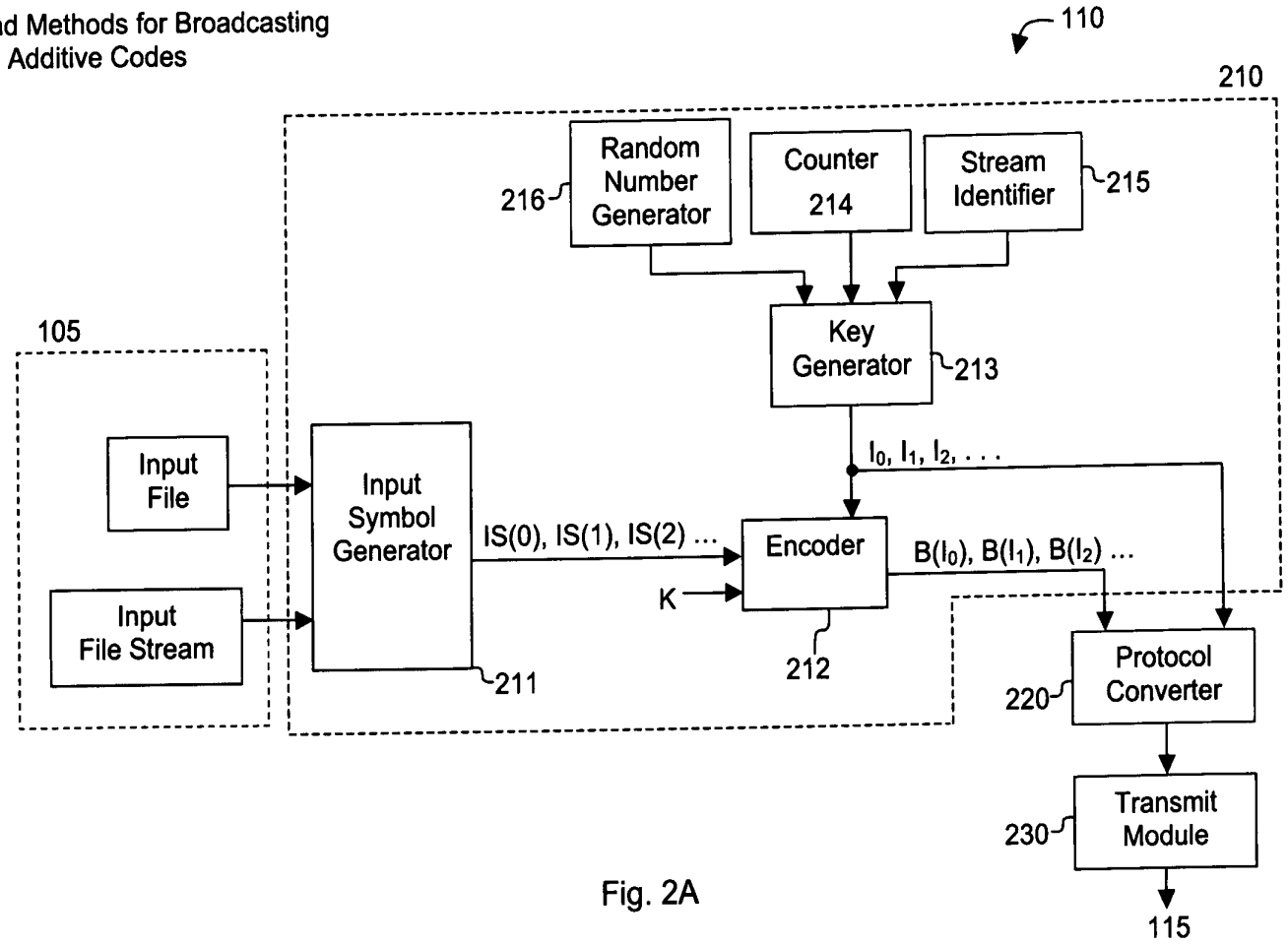
110
210
Random Number Generator
216
Counter 214
Stream Identifier
215
Key Generator
213
105
Input File
Input File Stream
Input Symbol Generator
211
IS(0), IS(1), IS(2) ...
K
Encoder
212
$I_0, I_1, I_2, \ldots$
$B(I_0), B(I_1), B(I_2) \ldots$
Protocol Converter
220
Transmit Module
230
115

Fig. 2A

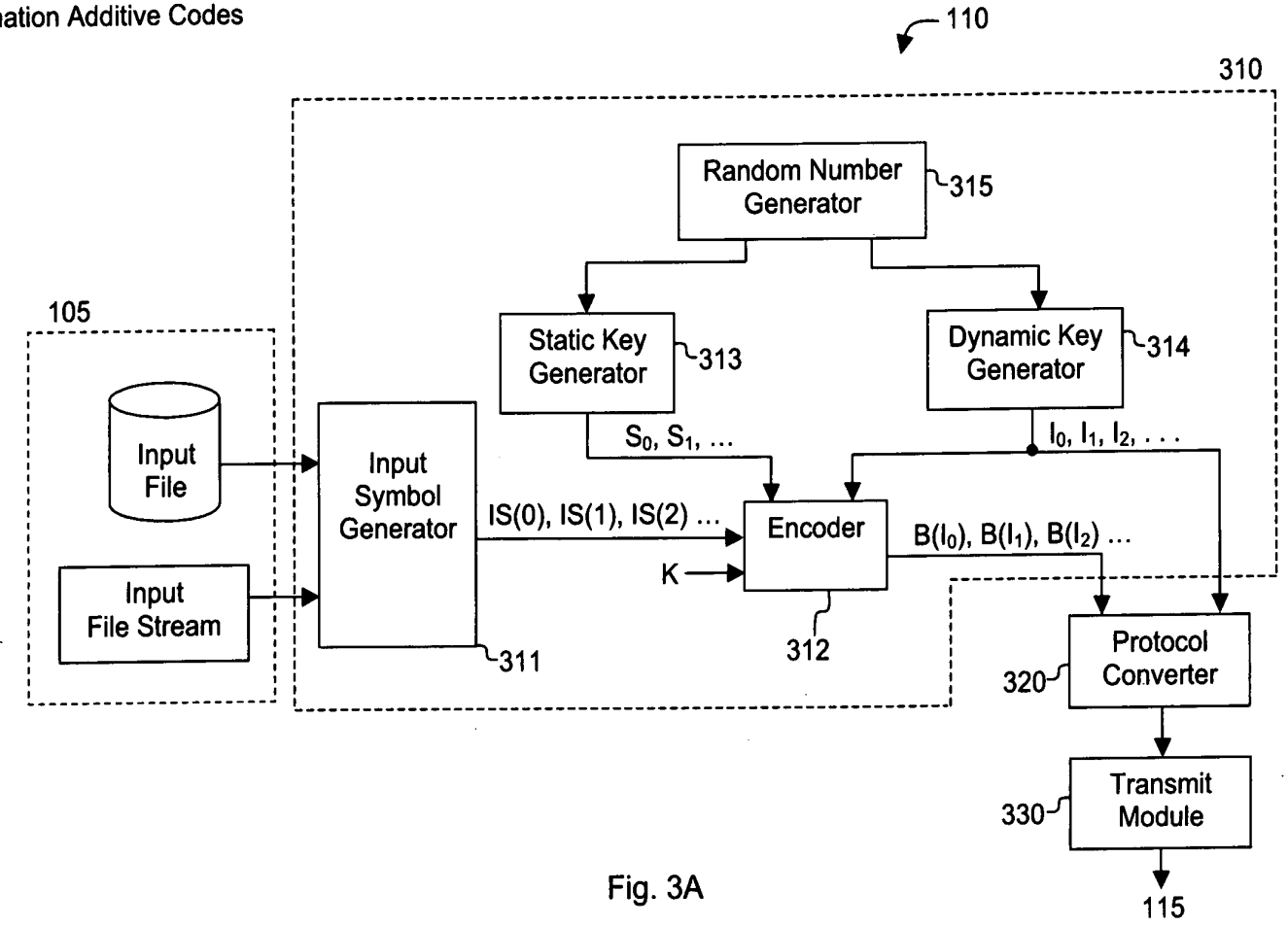
110
310
Random Number Generator
315
105
Static Key Generator
313
Dynamic Key Generator
314
Input File
Input Symbol Generator
$S_0, S_1, \ldots$
$I_0, I_1, I_2, \ldots$
IS(0), IS(1), IS(2) ...
Encoder
$B(I_0), B(I_1), B(I_2)$ ...
Input File Stream
K
312
311
Protocol Converter
320
Transmit Module
330
115

Fig. 3A

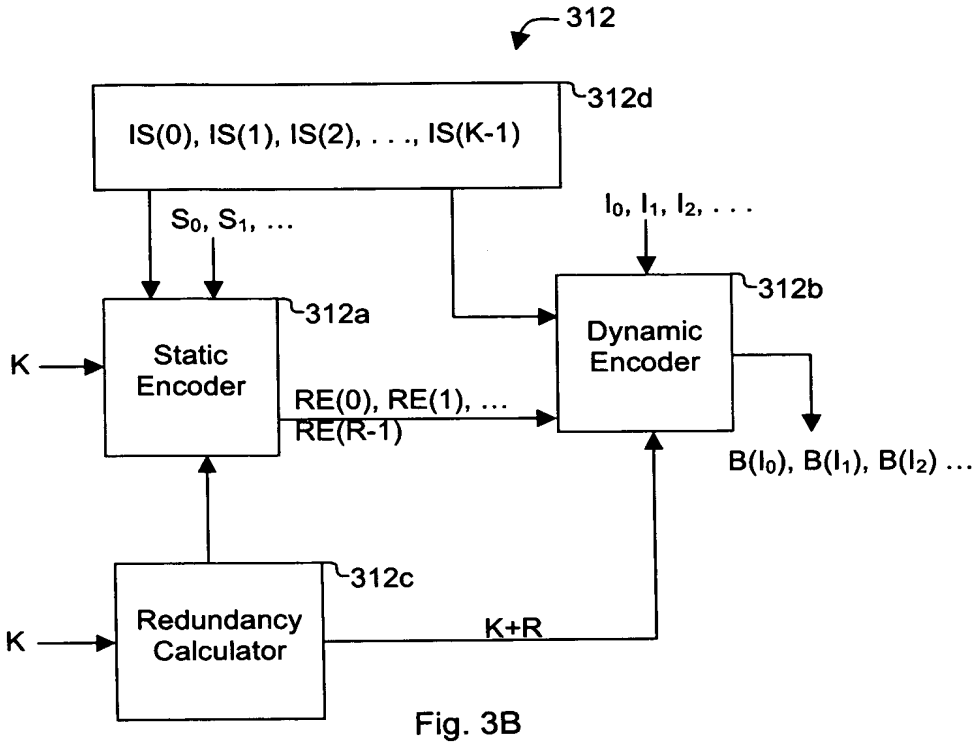
312
312d
IS(0), IS(1), IS(2), . . ., IS(K-1)
S_0, S_1, ...
I_0, I_1, I_2, . . .
312a
Static Encoder
K
RE(0), RE(1), ...
RE(R-1)
312b
Dynamic Encoder
$B(I_0)$, $B(I_1)$, $B(I_2)$ ...
312c
Redundancy Calculator
K
K+R

Fig. 3B

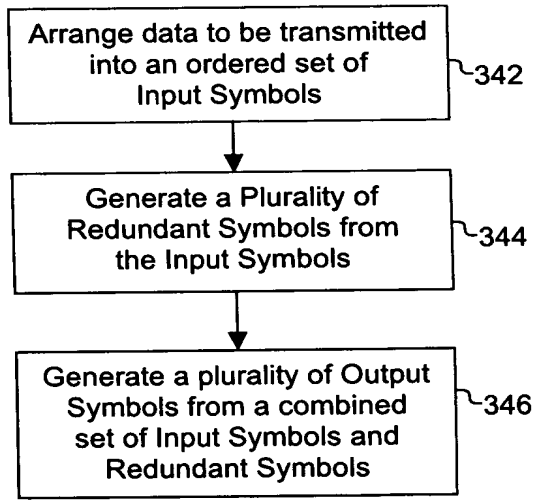
Arrange data to be transmitted into an ordered set of Input Symbols
342
Generate a Plurality of Redundant Symbols from the Input Symbols
344
Generate a plurality of Output Symbols from a combined set of Input Symbols and Redundant Symbols
346

Fig. 3C

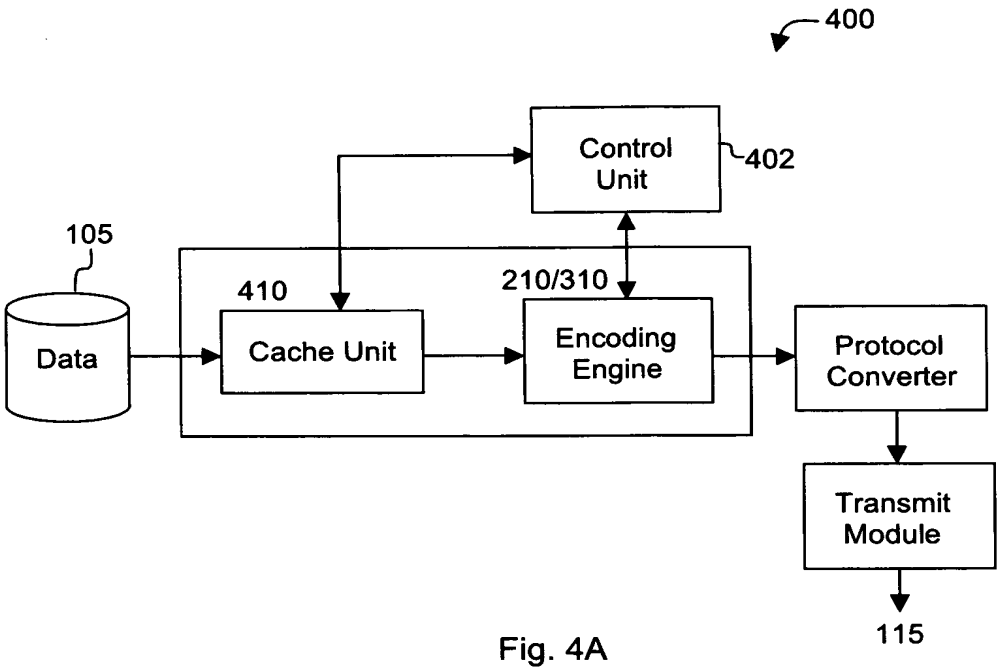
400
Control Unit
402
105
410
210/310
Data
Cache Unit
Encoding Engine
Protocol Converter
Transmit Module
115

Fig. 4A

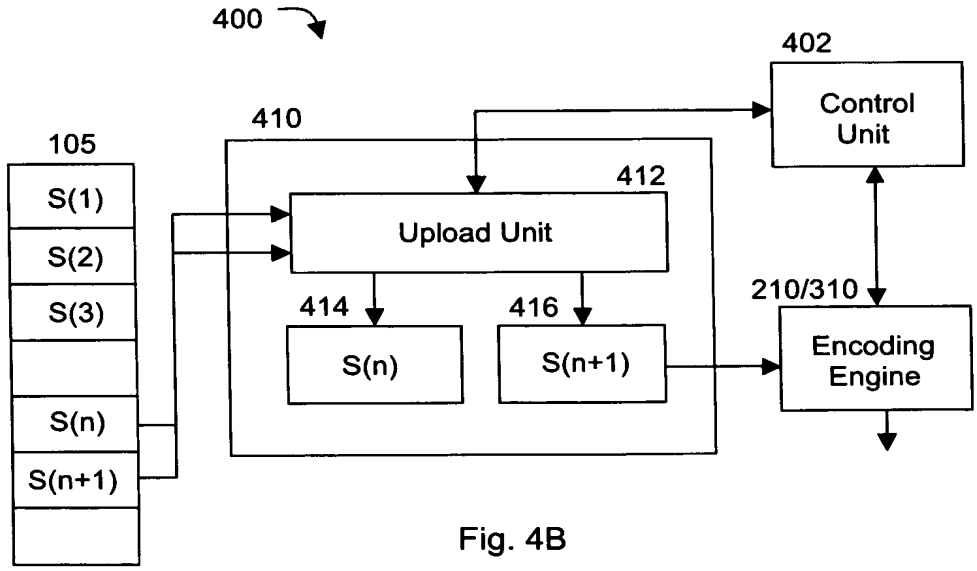
400
402
Control Unit
410
105
412
S(1)
S(2)
S(3)
Upload Unit
414
416
210/310
S(n)
S(n+1)
Encoding Engine

Fig. 4B

Systems and Methods for Broadcasting
Information Additive Codes

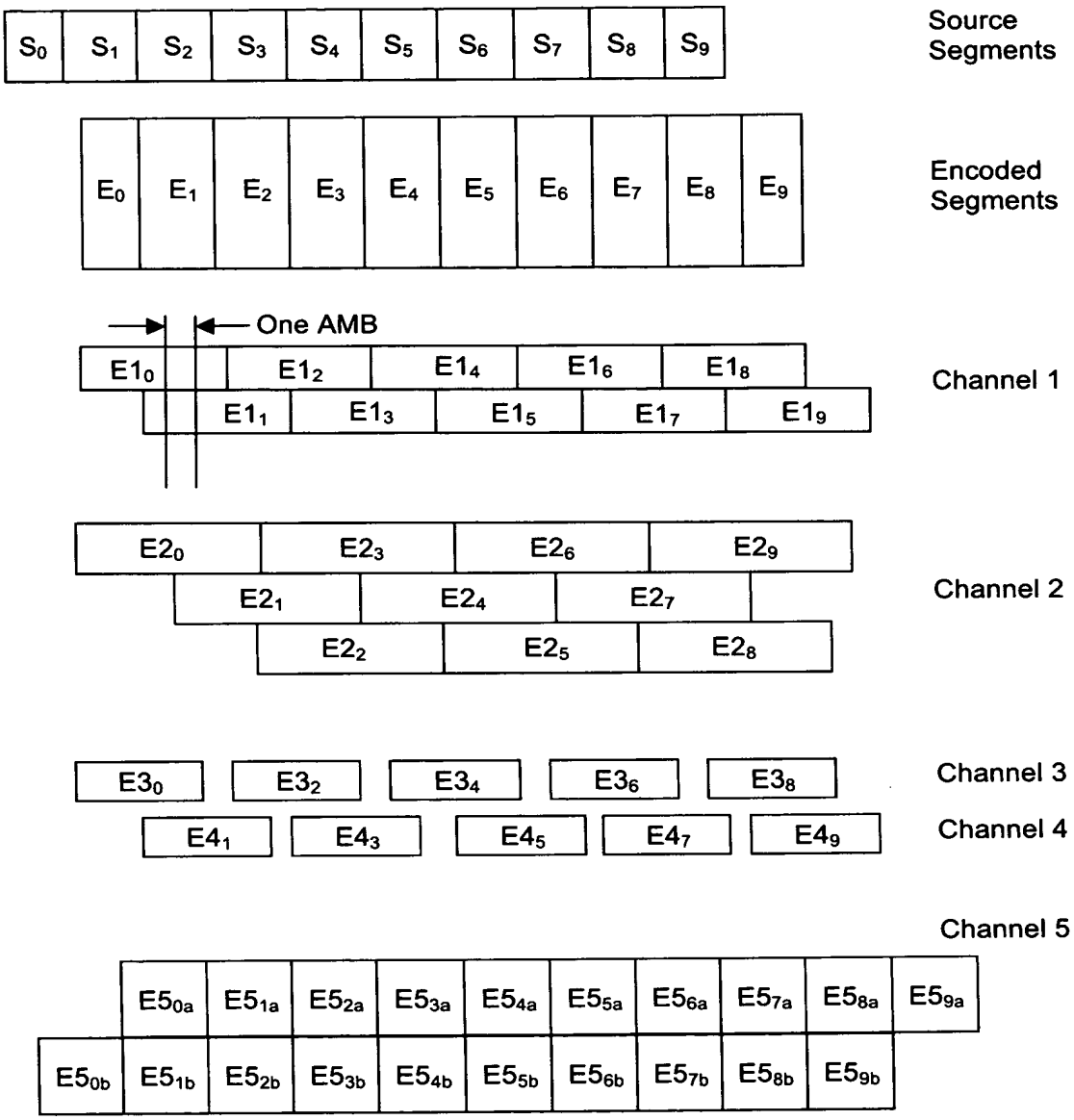

Fig. 5A

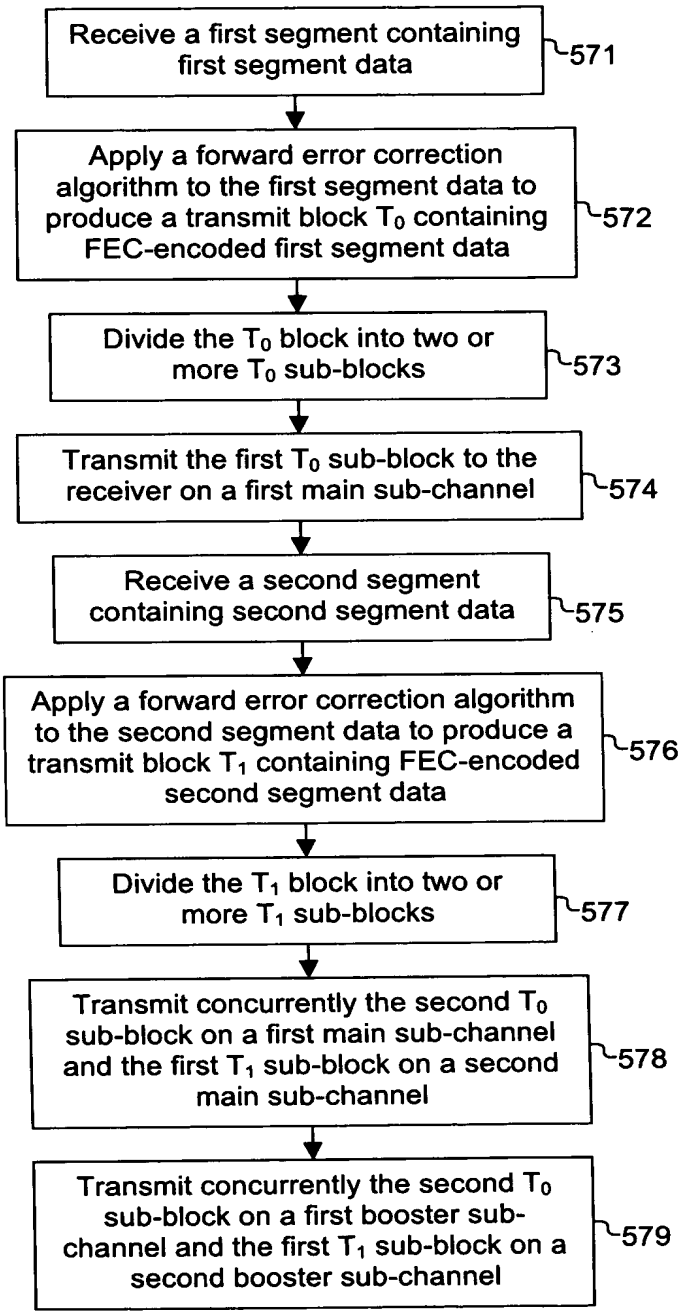
Receive a first segment containing first segment data
571
Apply a forward error correction algorithm to the first segment data to produce a transmit block T_0 containing FEC-encoded first segment data
572
Divide the T_0 block into two or more T_0 sub-blocks
573
Transmit the first T_0 sub-block to the receiver on a first main sub-channel
574
Receive a second segment containing second segment data
575
Apply a forward error correction algorithm to the second segment data to produce a transmit block T_1 containing FEC-encoded second segment data
576
Divide the T_1 block into two or more T_1 sub-blocks
577
Transmit concurrently the second T_0 sub-block on a first main sub-channel and the first T_1 sub-block on a second main sub-channel
578
Transmit concurrently the second T_0 sub-block on a first booster sub-channel and the first T_1 sub-block on a second booster sub-channel
579

Fig. 5B

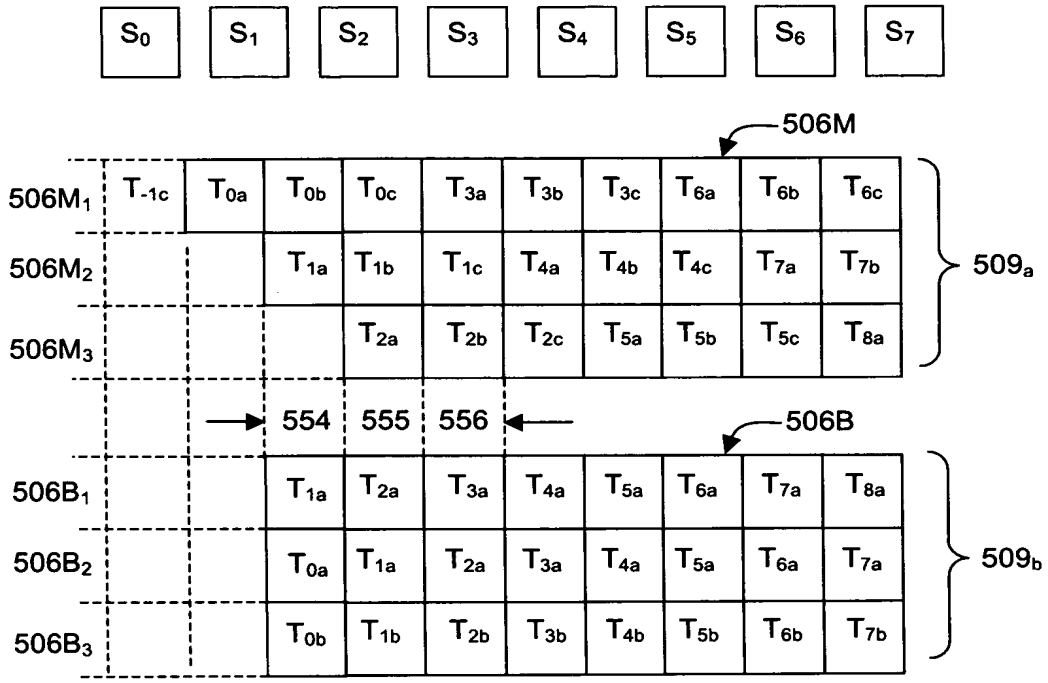
S0
S1
S2
S3
S4
S5
S6
S7
506M
506M1
506M2
506M3
T-1c
T0a
T0b
T0c
T3a
T3b
T3c
T6a
T6b
T6c
T1a
T1b
T1c
T4a
T4b
T4c
T7a
T7b
T2a
T2b
T2c
T5a
T5b
T5c
T8a
509a
554
555
556
506B
506B1
506B2
506B3
509b

Fig. 5C

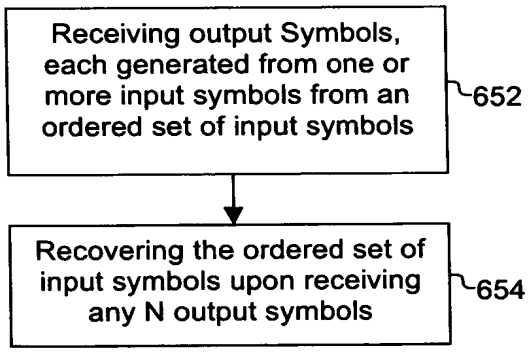
Receiving output Symbols, each generated from one or more input symbols from an ordered set of input symbols
652
Recovering the ordered set of input symbols upon receiving any N output symbols
654

Fig. 6B

Systems and Methods for Broadcasting Information Additive Codes

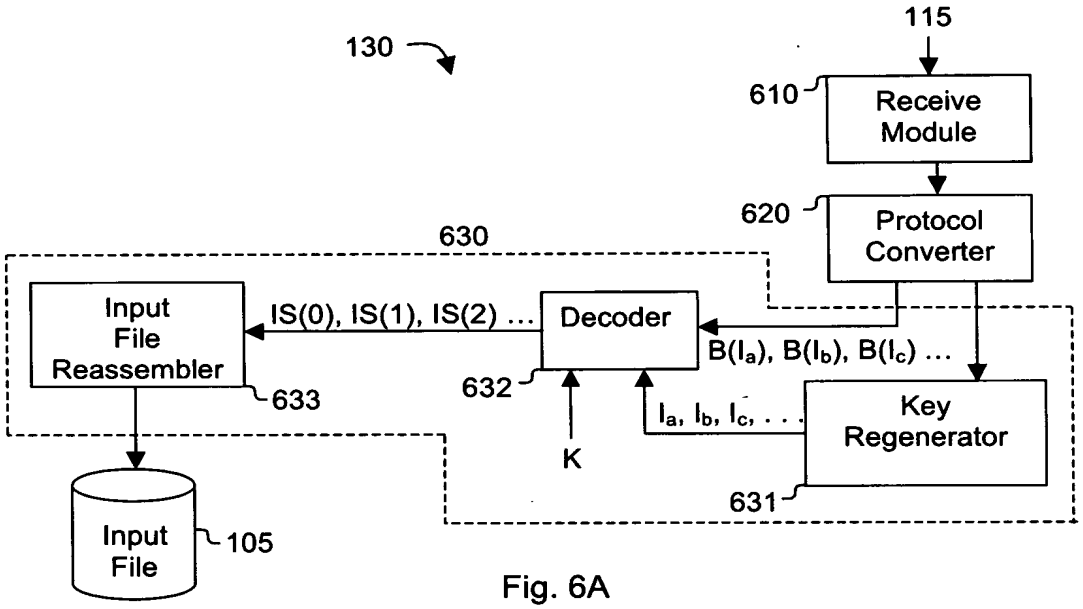

Fig. 6A

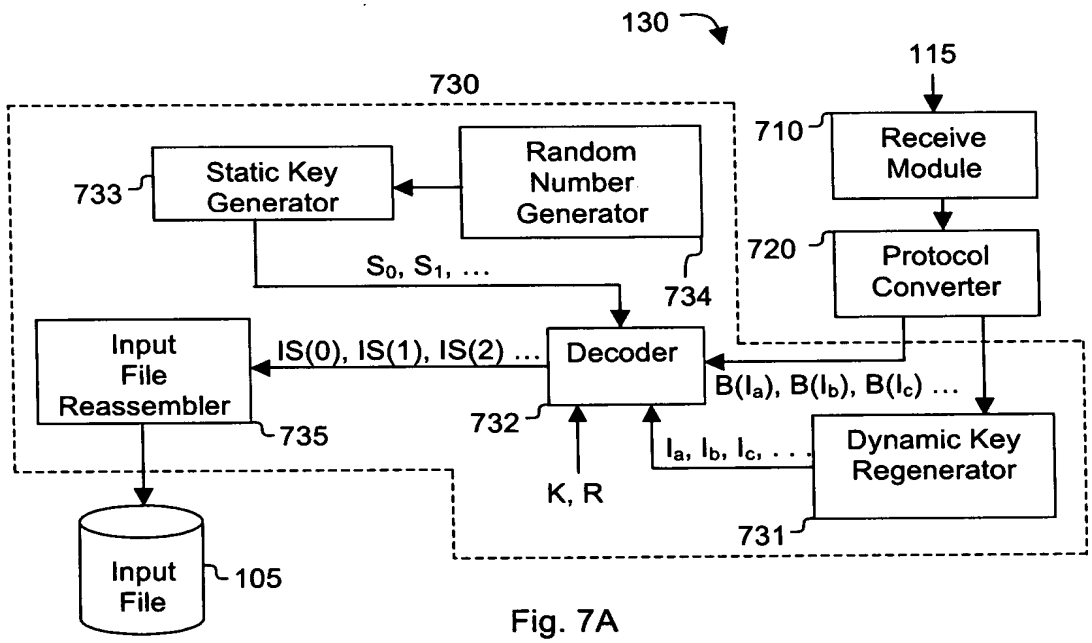

Fig. 7A

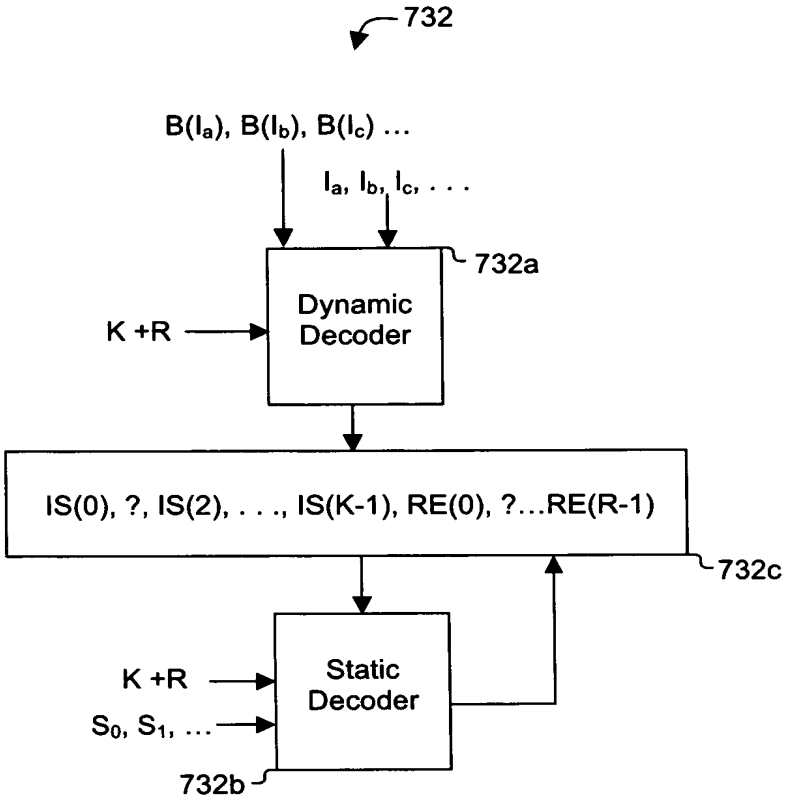
732
B(Ia), B(Ib), B(Ic) ...
Ia, Ib, Ic, . . .
732a
Dynamic Decoder
K +R
IS(0), ?, IS(2), . . ., IS(K-1), RE(0), ?...RE(R-1)
732c
Static Decoder
K +R
S0, S1, ...
732b

Fig. 7B

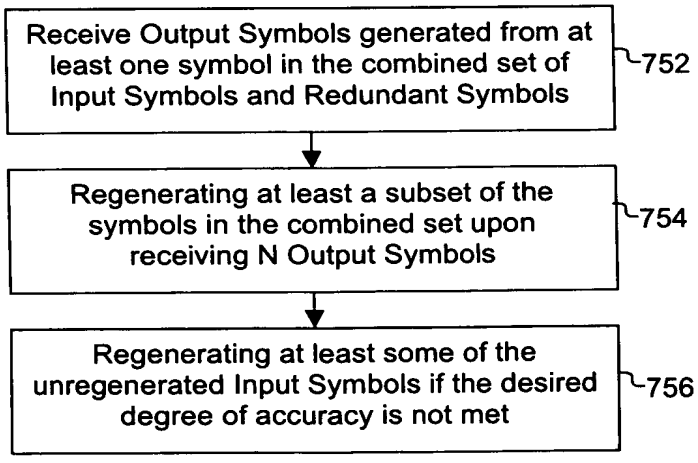
Receive Output Symbols generated from at least one symbol in the combined set of Input Symbols and Redundant Symbols
752
Regenerating at least a subset of the symbols in the combined set upon receiving N Output Symbols
754
Regenerating at least some of the unregenerated Input Symbols if the desired degree of accuracy is not met
756

Fig. 7C

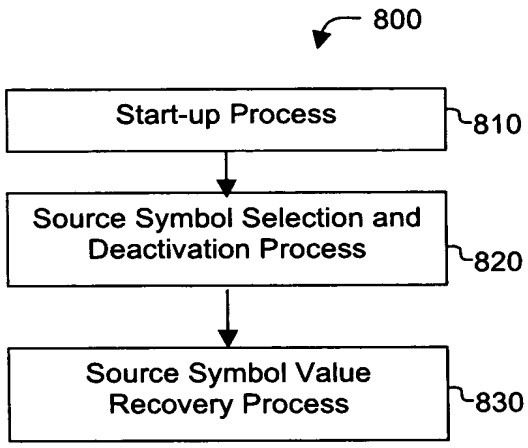
800
Start-up Process
810
Source Symbol Selection and Deactivation Process
820
Source Symbol Value Recovery Process
830

Fig. 8A

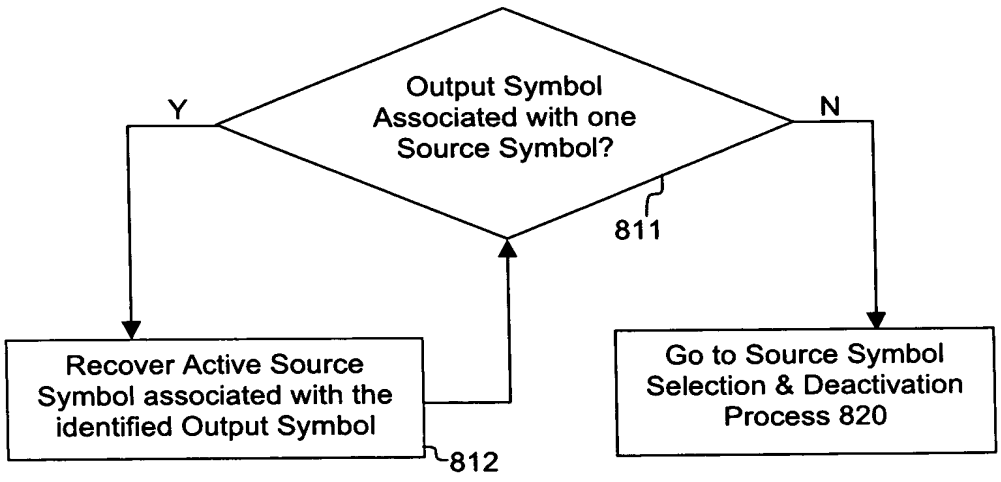
Output Symbol Associated with one Source Symbol?
Y
N
811
Recover Active Source Symbol associated with the identified Output Symbol
812
Go to Source Symbol Selection & Deactivation Process 820

Fig. 8B

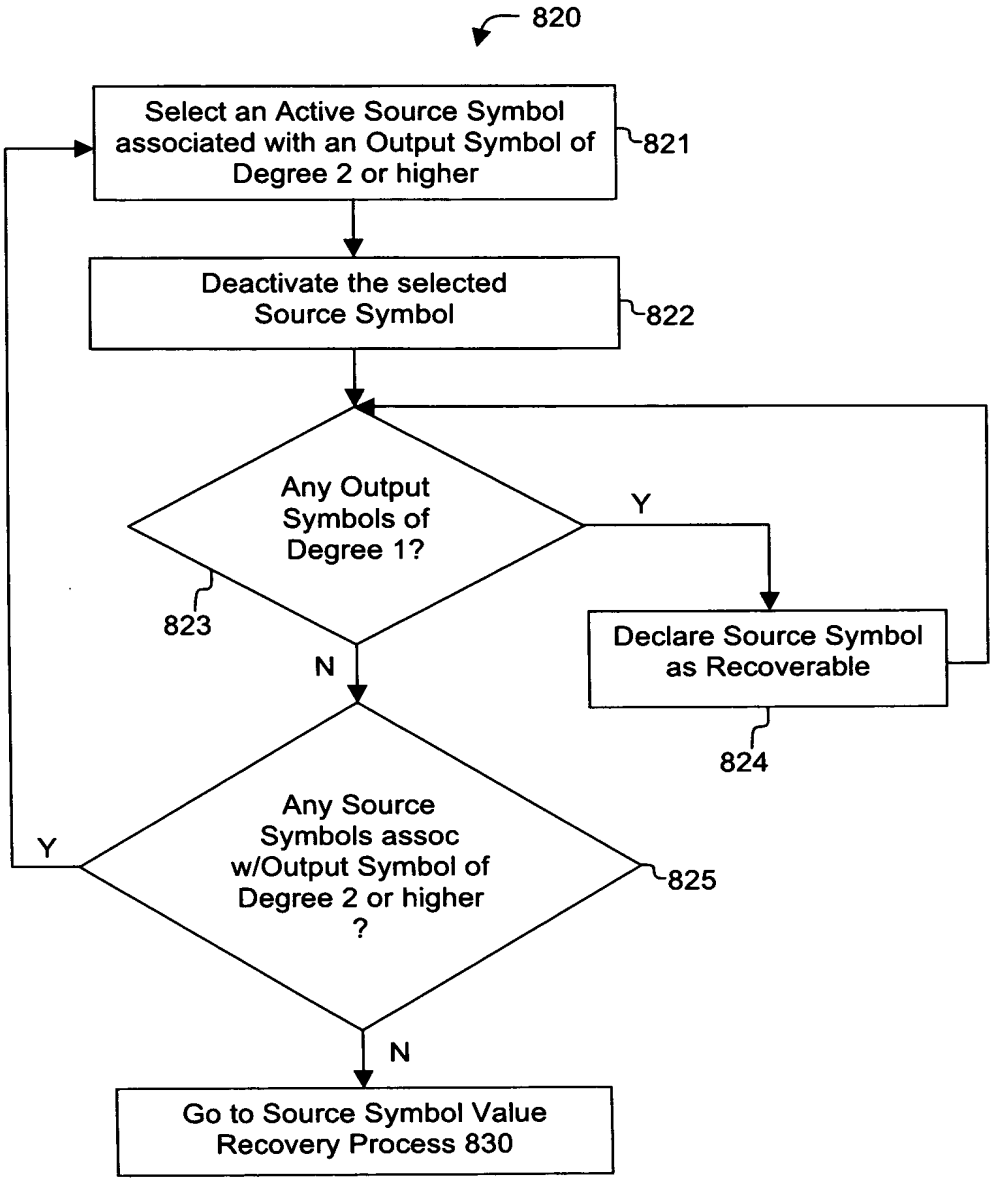
820
Select an Active Source Symbol associated with an Output Symbol of Degree 2 or higher
821
Deactivate the selected Source Symbol
822
Any Output Symbols of Degree 1?
823
Y
N
Declare Source Symbol as Recoverable
824
Any Source Symbols assoc w/Output Symbol of Degree 2 or higher ?
825
Y
N
Go to Source Symbol Value Recovery Process 830

Fig. 8C

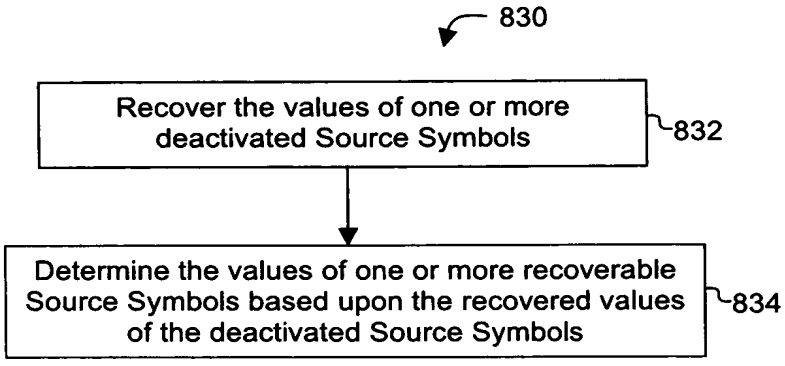
830
Recover the values of one or more deactivated Source Symbols
832
Determine the values of one or more recoverable Source Symbols based upon the recovered values of the deactivated Source Symbols
834

Fig. 8D

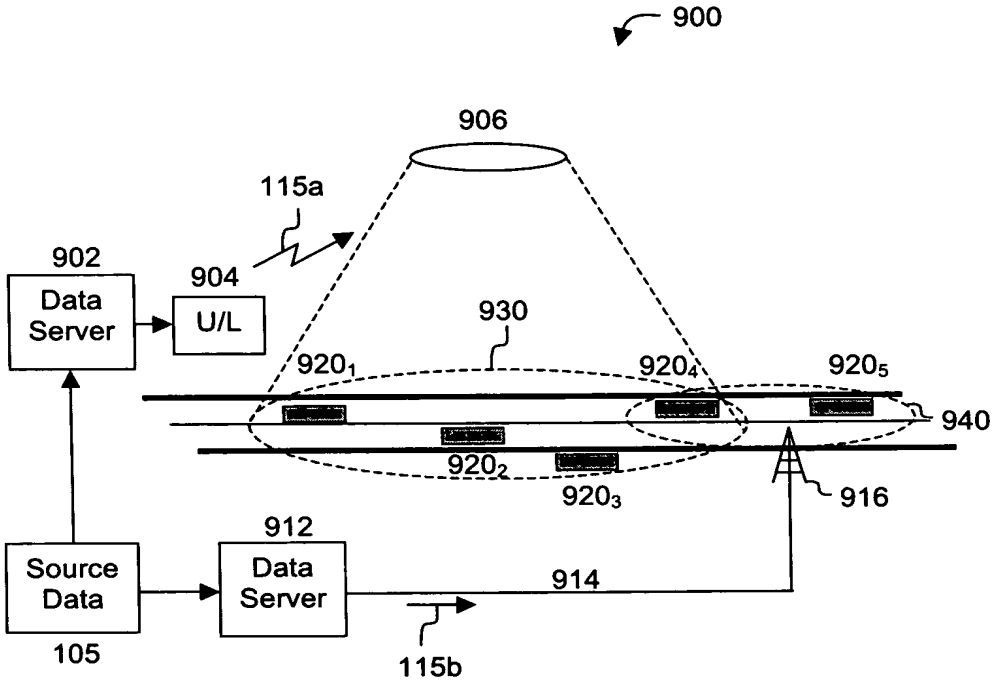
900
906
115a
902
Data Server
904
U/L
930
920_1
920_4
920_5
940
920_2
920_3
916
912
Source Data
Data Server
914
105
115b

Fig. 9A

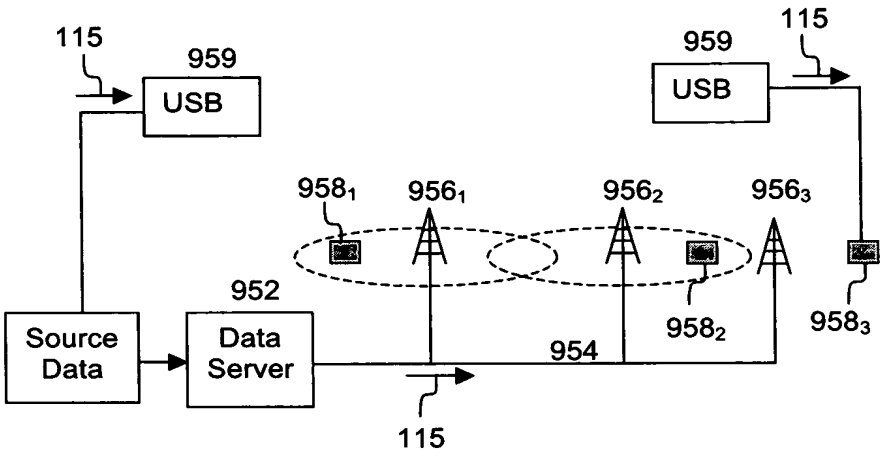
115
959
USB
115
959
USB
958_1
956_1
956_2
956_3
952
Source Data
Data Server
954
958_2
958_3
115

Fig. 9B